

IN THE CLAIMS

1 (currently amended): A thermal profiling device for a flip-chip integrated circuit comprising:

a packaging substrate of a flip-chip integrated circuit;  
a semiconductor die of the flip-chip integrated circuit having an active circuit surface for interconnecting the semiconductor die to the packaging substrate wherein the active circuit surface is secured directly to an ~~[[the]]~~ upper surface of the packaging substrate; and

a thermocouple secured directly to the ~~[[an]]~~ active circuit surface of the semiconductor die for measuring a temperature of the active circuit surface of the semiconductor die during a reflow process.

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2 (previously presented): The thermal profiling device of Claim 1 wherein the thermocouple is secured using an adhesive.

3 (previously presented): The thermal profiling device of Claim 2 wherein the adhesive comprises an epoxy.

4 (previously presented): The thermal profiling device of Claim 1 wherein the active circuit surface has electrically conductive bumps formed thereon and the upper surface of the packaging substrate includes a plurality of bonding pads wherein the semiconductor die is positioned on the packaging substrate such that the electrically conductive bumps are in electrical contact with the plurality of bonding pads.

5 (previously presented): The thermal profiling device of Claim 4 wherein the packaging substrate and the semiconductor die are secured in place by a solder bond

between the electrically conductive bumps and the plurality of bonding pads.

6 (previously presented): A thermal profiling device comprising:

a packaging substrate of a flip-chip integrated circuit having a first surface and a second opposite surface;

an opening passing through the second opposite surface and through the first surface of the packaging substrate;

a semiconductor die of the flip-chip integrated circuit having an active circuit surface for interconnecting the semiconductor die to the packaging substrate wherein the active circuit surface is secured directly to the first surface of the packaging substrate; and

a thermocouple secured directly to the active circuit surface of the semiconductor die through the opening for measuring a temperature of the active circuit surface of the semiconductor die during a reflow process.

7 (canceled)

8 (withdrawn): A method of constructing a device for accurately measuring the temperature of a semiconductor device at an interface between a semiconductor die and a packaging substrate, the method comprising the steps of:

a. providing a semiconductor die, said die including an active circuit surface electrically conductive bumps formed thereon;

b. removing said bumps from said semiconductor die;

c. providing a packaging substrate, said substrate including a first surface for receiving said

semiconductor die and an opposite second side;

- d. providing a thermocouple; and
- e. securing the active surface of said die to the first surface of said substrate such that said thermocouple is positioned between the active surface of said die and the first surface of said substrate.

9 (withdrawn): A method as in Claim 8, wherein said step e), of securing said thermocouple between said die and said first surface, includes the steps of:

- cii) treating said thermocouple with epoxy;
- ciii) contacting the epoxy treated thermocouple to the active surface of said die;
- civ) contacting the epoxy treated thermocouple and the active surface of said die to the first surface of said substrate such that said thermocouple is positioned between the active surface of said die and the first surface of said substrate;
- cv) clamping said thermocouple in place between the active surface of said die and the bonding pad;
- cvi) curing the epoxy; and
- cvii) securing said die, said thermocouple, and said substrate in place by soldering said die to said substrate.

10 (withdrawn): A method as in Claim 9, wherein said step iv), of clamping said thermocouple between said die and said first surface of said packaging substrate, includes the steps of:

- A. providing a stiffener sized to securely fit around said die, said stiffener including a

- passage sized to pass said thermocouple through said passage;
- B. positioning said stiffener on said first surface of said packaging substrate such that the stiffener fits around said die and allows said thermocouple to fit through the passage;
  - C. providing a heat spreader;
  - D. clamping said heat spreader in position on said stiffener such that said die, said stiffener, and said thermocouple are all held in place while said epoxy cures; and
  - E. after curing the epoxy, removing the heat spreader and the stiffener, leaving the thermocouple epoxied in place between the substrate and die.
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11 (withdrawn): A method as in Claim 8, wherein said step e), of securing said thermocouple between said die and said first surface of the packaging substrate, includes the steps of:

- i) placing said die on the first surface of said substrate such that the electrically conductive bumps of said die are in contact with a plurality of bonding pads formed on said first surface of said substrate; and
- ii) reflowing said electrically conductive bumps such that said bumps are secured to said plurality of bonding pads of said substrate to secure said die in place;
- iii) forming an opening in said second side of said substrate, said opening passing through said substrate enabling contact with the active

- surface of said die;
- iv) urging said thermocouple into contact with the active surface of said die by inserting said thermocouple into said opening;
  - v) filling said opening with an epoxy to secure said thermocouple; and
  - vi) curing the epoxy.
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